DOI: 10.7860/JCDR/2023/64639.18319

Review Article

Ear, Nose and Throat Section

Significance of Internal Nasal Valve and Nasal Septal Swell Body in Improving the Outcome of Septoplasty: A Literature Review

SENU SUNNYCHAN[1], PRASAD DESHMUKH[2], SAGAR GAURKAR[3]

ABSTRACT

Nasal obstruction is a common presenting symptom for both primary care physicians and otolaryngologists, and it can be caused by various anatomic, physiologic, and pathophysiologic factors. Structural nasal obstruction may result from a Deviated Nasal Septum (DNS), Internal Nasal Valve (INV) obstruction, External Nasal Valve (ENV) obstruction, inferior turbinate hypertrophy, Nasal Septal Swell Body (NSB) etc. Combined causes occasionally go unnoticed, and postoperative symptom relief may not always be satisfactory. Revision surgeries in cases where septoplasty fails due to misdiagnosed multicausative factors can increase the complexity of the procedure, further affecting its success. In this review, our objective is to examine the significance of the NSB and the INV, which are often overlooked nasal structures, in improving the outcomes of septoplasty. Upon reviewing the findings, it can be confirmed that diagnosing these overlooked structures has led to improved outcomes in septoplasty and, consequently, the quality of life for patients with nasal obstruction.

Keywords: Deviated nasal septum, Limen nasi, Nasal obstruction, Nasal resistance, Revision nasal surgery, Septal turbinate, Sinusitis, Upper lateral cartilage

INTRODUCTION

One of the most common procedures in otorhinolaryngology practice is septoplasty, and the surgeon needs to be certain that the nasal obstruction symptoms pertain to this anatomical deformity. The INV is an active part of the respiratory airways and plays a crucial role in breathing [1]. It is responsible for the majority of the nose passage's resistance [2]. While at rest, this section of the respiratory system accounts for approximately half of the total airflow resistance in the system, although the effort required to breathe through this segment is well-utilised [3].

The nasal valve consists of four different components that contribute to airflow-resistive components, which include the area between the septum and the caudal end of the upper lateral cartilage, the bony entrance to the nasal cavity, the nasal septum, and the lateral turbinate walls. Airflow encounters minimal resistance when passing through the main body of the nasal cavity. Inspiratory air experiences "orifice flow" as it enters the nasal cavity due to valve constriction, disrupting the laminar properties of the air and increasing heat, water, and pollutant exchanges with the nasal mucosa [4].

The NSB is the enlarged portion of the anterior nasal septum located in front of the middle turbinate. It is crucial to differentiate between this area, also known as the septal turbinate, and a septal deviation in this area [5]. The NSB consists of the bony and cartilaginous parts of the nasal septum, as well as swollen tissues involving the bones and cartilages near the end of the INV, which serve as a mechanical barrier. This region has been found to contain glandular and vaso-erectile tissue, as well as a significant number of venous sinusoids like those found in the inferior turbinate, all of which can affect nasal airflow [6]. Due to the NSB's proximity to the INV, which is the area of greatest resistance to nasal airflow, septoplasty often fails to provide the desired postoperative symptomatic relief. This is because these structures are frequently overlooked, as noted in previous literature [7,8].

In this review, our aim was to assess the importance of the INV and NSB in improving the outcomes of septoplasty using available data and studies from around the world.

LITERATURE SEARCH

A comprehensive review was conducted, screening case series and review articles from 2008 to 2023 via Medline/PubMed research. The search utilised keywords such as (INV) AND (septoplasty), (septal body) AND (septoplasty), and failed septoplasty. Only full English articles that provided a detailed analysis of the INV, NSB, and their impact on septoplasty were selected. Special attention was given to literature that described the location and measurement techniques of the INV. The selected articles were meticulously reviewed, and observations were made [Table/Fig-1] [9-16].

S. No.	Study	Year	Place of study	Type of study	Sample size	Factors considered for nasal obstruction	Postsurgery outcome
1	Becker SS et al., [9]	2008	United States	Retrospective study	70	Septal deviations and their sites, sinusitis, inferior turbinate hypertrophy, nasal valve (less considered)	Significant number of patients had Internal Nasal Valve (INV) revision surgery. (p=0.074)
2	Gillman GS et al., [10]	2014	United States	Prospective study	40	Septal deviation	Revision surgery had to address deviations over dorsal septum (92%) and caudal septum (72%) as these areas affected airflow through the nasal valve. Mean Nasal Obstruction Symptom Evaluation (NOSE) scores decreased significantly from 75.9 preoperatively to 14.9 at three months after revision surgery (p<0.0001)
3	Kahraman E et al., [11]	2016	Turkey	Prospective study	10	Septal deviation and INV obstruction	Marked improvement in NOSE scale scores after surgery (preoperative mean NOSE score of 15.4 to postoperative score of 2.4)

4	Chambers KJ et al., [12]	2015	United States	Observation study	40	Deviated Nasal Septum (DNS)	Revision septoplasty due to failure to recognise nasal valve deformity during evaluation for nasal obstruction (98%) requires the patient to undergo two surgeries in addition to morbidity by demanding remote cartilage harvest/implant ($p<0.01$)
5	Catalano P et al., [13]	2015	United States	Prospective study	60	Nasal Septal Swell Body (NSB)	Marked improvement in NOSE scale scores in failed septoplasty, turbinoplasty as well as nasal valve repair patients ($p<0.001$)
6	Kim SJ et al., [14]	2016	Korea	Retrospective clinical series	8	NSB	Significant improvement in Visual Analogue Scale (VAS) score postprocedure along with an increased patency in the INV area ($p<0.05$)
7	Derin S et al., [15]	2016	Turkey	Cross-sectional study	50	Septal deviation	Revision surgery had to address nasal valve (6% cases), improper septal correction and inferior turbinate hypertrophy
8	Bhoyar SS et al., [16]	2021	India	Retrospective study	400	Septal deviation and INV obstruction	Majority (98%) had significant symptomatic relief from difficulty in breathing

[Table/Fig-1]: Summary of reviewed articles [9-16].

DISCUSSION

The term "nasal valve" was initially introduced by Mink to describe the narrowed region within the nasal vestibule. In their research on nasal airflow, Bridger and Proctor referred to this area as the "Flow-Limiting Segment" (FLS), typically located beyond the limen nasi in the region of the piriform aperture. The FLS is defined inferiorly by the head of the inferior turbinate, medially by the dorsal septum, and laterally by the caudal section of the upper lateral cartilage. It is approximately 1.3 cm from the nares [15-18].

The functional nasal valve is the most common site of pathological obstruction to nasal airflow, and if not properly diagnosed, it can affect paranasal sinus and middle ear ventilation [19-23]. Causes of INV obstruction can include a high septal deviation, enlarged turbinate (static structural abnormality), or compromised integrity of the upper lateral cartilage/lateral nasal wall, which can lead to dynamic collapse of the upper lateral cartilage or nasal sidewall [18,19,24].

The cross-sectional area of the nasal valve determines the extent of airflow restriction, and this relationship is inverse and exponential. Even a small 1 mm shift in either valve wall can significantly alter resistance. While such displacement may not be visible during rhinoscopy, its impact on resistance can be immediately assessed using rhinomanometry, and slight dimensional aberrations in the valve region can be precisely measured using acoustic rhinometry [25]. Therefore, as the area with the highest nasal resistance, any reduction in this already narrow region can cause a significant decrease in nasal airflow. The proximity of the NSB to the INV further amplifies the effect of any pathological factors causing nasal obstruction in this area.

In 1662, Morgagni described the NSB, also known as intumescentia septi nasii anterior, as a mucosal protrusion on the anterior part of the septum. Despite being frequently and easily visible in most Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) scans of the nose, this septal erectile tissue has not received much attention in rhinological research or rhinometry [26,27]. Studies by Delank KW et al., and Arslan M et al., identified septal bodies in 66.4% and 55.8% of cases, respectively, with a higher prevalence in males [28,29]. Despite the significant occurrence of the NSB, Melati T et al., found that it is often overlooked as a structural variation in their analysis of 595 paranasal sinus CT scans [21].

Cole P et al., reported that the amount of erectile tissue on the anterior septum can change in response to posture changes and the administration of decongestants, which can significantly impact airflow resistance [26,27]. Cole P and Roithmann R hypothesised that shrinking of the NSB could lead to increases in the acoustic rhinogram at the minimal cross-sectional area within the first 2 cm of the nasal cavity following decongestion [25]. Catalano P et al., studied the role of the NSB in patients with persistent nasal obstruction after conservative and surgical management, including septoplasty [13]. They observed a significant improvement in the Nasal Obstruction Symptom Evaluation (NOSE) score three months after radiofrequency ablation of the NSB (from 41.6 to 17). Similarly, a study by Kim SJ et al., in patients with persistent nasal obstruction following failed medical management showed a significant improvement in Visual Analogue Scale (VAS) scores for nasal obstruction (from 7.63 to 4.63) after coblation of the NSB, along with increased patency in the INV area [14]. Another study by Yu MS et al., demonstrated significant improvement in VAS scores for nasal obstruction (from 7.52 to 1.4), as well as acoustic rhinogram measurements (mean cross-sectional area improved from 0.37 cm^2 to 0.55 cm^2), in patients with NSB hypertrophy and inferior turbinate hypertrophy [30]. These studies highlight the etiological role of the NSB in persistent nasal obstruction and the promising improvement in surgical outcomes if NSB is not overlooked.

The NOSE scale was used by Kahraman E et al., to assess the effects of nasal obstruction following various nasal surgeries in 40 young adult patients [11]. They found that the postoperative NOSE scale scores significantly decreased from a preoperative mean of 15.4 (77%) to 2.4 (12%) in patients who underwent repair of both the INV and the nasal septum. This finding is consistent with the study by Bhoyar SS et al., which showed that 98% of patients who underwent septoplasty with INV repair experienced significant relief from breathing difficulties [16]. In the context of prior septoplasty with ongoing nasal obstruction symptoms, Chambers KJ et al., demonstrated significant improvement in nasal function, as measured by the NOSE survey, in patients who underwent nasal valve repair [12]. These findings clearly indicate that surgical correction of INV obstruction can enhance the outcomes of septoplasty and alleviate symptoms of nasal valve obstruction.

Studies by Becker SS et al., and Gillman GS et al., highlight the potential reasons for prolonged nasal obstruction following septoplasty, including undetected nasal valve narrowing and/or collapse, which may be attributed to underappreciation of structural impairment during the initial evaluation [9,10]. In a review by Becker SS et al., it was found that while only 19% of patients who underwent non-revision surgery had simultaneous surgery to address nasal valve collapse, over half (51%) of the 70 patients who required revision septoplasty underwent such surgery [9]. Interestingly, only one patient (4% of the 25 patients who underwent both their first and revision surgery) had nasal valve surgery during the initial procedure. Furthermore, patients who required nasal valve surgery during revision septoplasty had a significantly longer time between their first and revision surgeries compared to those who underwent revision septoplasty alone (7.5 years versus 3.2 years). These findings support the notion that nasal valve collapse is often misdiagnosed and that approximately 50% of patients who require revision septoplasty still have nasal valve collapse despite experiencing symptom improvement.

Delank KW et al., investigated endonasal airflow in a nasal model with the presence of the septal protuberance, demonstrating that the intumescentia significantly alters the quality and local velocities of the endonasal airstream [28]. Miman MC et al., described the

NSB as an underappreciated nasal structure that should be recognised as a clinical entity due to its noticeable impact on rhinomanometry [17]. These studies highlight the potential for improved outcomes in septoplasty if accurate evaluations are performed. Surgeons should be aware that subjective improvement following septoplasty depends not only on the proper execution of the procedure but also on the identification of the multifactorial causes contributing to nasal obstruction. To enhance the quality of life offered by septoplasty, it is crucial to accurately diagnose nasal obstruction and consider the multifactorial etiologies, emphasising the importance of not overlooking the INV and NSB.

CONCLUSION(S)

This review focused on emphasising the effect of underdiagnosed entities of nasal obstruction, particularly the INV and NSB. Due to the NSB's proximity to the INV, which is the area of highest resistance to nasal airflow, septoplasty often fails to provide the desired postoperative symptomatic relief. This is because these structures are frequently overlooked. The effectiveness of septoplasty can be improved by considering the multifactorial causes of nasal obstruction and evaluating the pathophysiological roles of the INV and NSB. Revision surgeries in cases of unsuccessful septoplasty due to misdiagnosed multifactorial factors increase the complexity of the procedure, further compromising its success.

REFERENCES

[1] Murthy VA, Reddy RR, Pragadeeswaran K. Internal nasal valve and its significance. Indian J Otolaryngol Head Neck Surg. 2013;65(Suppl 2):400-01.
[2] Tripathi PB, Elghobashi S, Wong BJF. The myth of the internal nasal valve. JAMA Facial Plast Surg. 2017;19(4):253-54.
[3] Sahin-Yilmaz A, Naclerio RM. Anatomy and physiology of the upper airway. Proc Am Thorac Soc. 2011;8(1):31-39.
[4] Cole P, Chaban R, Naito K, Oprysk D. The obstructive nasal septum. Effect of simulated deviations on nasal airflow resistance. Arch Otolaryngol Head Neck Surg. 1988;114(4):410-12.
[5] Elwany S, Salam SA, Soliman A, Medanni A, Talaat E. The nasal septal swell body revisited. J Laryngol Otol. 2009;123(3):303-08.
[6] Wexler D, Braverman I, Amar M. Histology of the nasal septal swell body (septal turbinate). Otolaryngol Head Neck Surg. 2006;134(4):596-600.
[7] Teichgraeber JF, Wainwright DJ. The treatment of nasal valve obstruction. Plast Reconstr Surg. 1994;93(6):1174-82; discussion 1183-84.
[8] Meng X, Zhu G. Nasal septal swell body: A distinctive structure in the nasal cavity. Ear Nose Throat J. 2021;1455613211010093. (Online ahead of print).
[9] Becker SS, Dobratz EJ, Stowell N, Barker D, Park SS. Revision septoplasty: Review of sources of persistent nasal obstruction. Am J Rhinol. 2008;22(4):440-44.
[10] Gillman GS, Egloff AM, Rivera-Serrano CM. Revision septoplasty: A prospective disease-specific outcome study. Laryngoscope. 2014;124(6):1290-95.
[11] Kahraman E, Cil Y, Incesulu A. The effect of nasal obstruction after different nasal surgeries using acoustic rhinometry and nasal obstruction symptom evaluation scale. World J Plast Surg. 2016;5(3):236-43.
[12] Chambers KJ, Horstkotte KA, Shanley K, Lindsay RW. Evaluation of improvement in nasal obstruction following nasal valve correction in patients with a history of failed septoplasty. JAMA Facial Plast Surg. 2015;17(5):347-50.
[13] Catalano P, Ashmead MG, Carlson D. Radiofrequency ablation of septal swell body. Ann Otolaryngol Rhinol. 2015;2(11):1069.
[14] Kim SJ, Kim HT, Park YH, Kim JY, Bae JH. Coblation nasal septal swell body reduction for treatment of nasal obstruction: A preliminary report. Eur Arch Otorhinolaryngol. 2016;273(9):2575-78.
[15] Derin S, Sahan M, Deveer M, Erdogan S, Tetiker H, Koseoglu S. The causes of persistent and recurrent nasal obstruction after primary septoplasty. J Craniofac Surg. 2016;27(4):828-30.
[16] Bhoyar SS, Kashid GM, Gaikwad A, Purohit SA, Gupta AS, Waghmare SK, et al. Significance of inner nasal valve in septoplasty. VIMS Health Sci J. 2021;8(1):03-08.
[17] Miman MC, Deliktaş H, Ozturan O, Toplu Y, Akarçay M. Internal nasal valve: Revisited with objective facts. Otolaryngol Head Neck Surg. 2006;134(1):41-47.
[18] Patel B, Virk JS, Randhawa PS, Andrews PJ. The internal nasal valve: A validated grading system and operative guide. Eur Arch Otorhinolaryngol. 2018;275(11):2739-44.
[19] Hosseini S, Schuman TA, Walenga R, Wilkins JV, Babiskin A, Golshahi L. Use of anatomically-accurate 3-dimensional nasal airway models of adult human subjects in a novel methodology to identify and evaluate the internal nasal valve. Comput Biol Med. 2020;123:103896.
[20] Sunnychan S, Deshmukh P. Association between anterior rhinoscopic/ endoscopic assessment of internal nasal valve and various nasal deformities in the rural population of Vidarbha region of India: A cross-sectional study. Cureus. 2023;15(3):e35682.
[21] Melati T, Reksodiputro MH, Koento T, Iljanto S. Analysis of internal nasal valves shapes and angle due to nasal obstruction in Asian nose. eJ Kedokteran Indonesia. 2022;10(3):212-18.
[22] Deshmukh PT, Jain S. A review on deviated nasal septum: Classification, clinical features and management. J Pharm Res Int. 2021:33(60A);432-37.
[23] Shemirani NL, Rhee JS, Chiu AM. Nasal airway obstruction: Allergy and otolaryngology perspectives. Ann Allergy Asthma Immunol. 2008;101(6):593-98.
[24] Matteo G, Giorgio C. The clinical importance of the nasal valve. Acta Biomed. 2019;90(Suppl 2):31-33.
[25] Cole P, Roithmann R. The nasal valve and current technology. Am J Rhinol. 1996;10(1):23-38.
[26] Cole P, Haight JSJ, Naito K, Kucharczyk W. Magnetic resonance imaging of the nasal airways. Am J Rhinol. 1989;3(2):63-67.
[27] Cole P, Haight JS, Cooper PW, Kassel EE. A computed tomographic study of nasal mucosa: Effects of vasoactive substances. J Otolaryngol. 1983;12(1):58-60.
[28] Delank KW, Keller R, Stoll W. Morphology and rhinologic importance of intumescentia septi nasi anterior. Laryngorhinootologie. 1993;72(5):242-46.
[29] Arslan M, Muderris T, Muderris S. Radiological study of the intumescentia septi nasi anterior. J Laryngol Otol. 2004;118(3):199-201.
[30] Yu MS, Kim JY, Kim BH, Kang SH, Lim DJ. Feasibility of nasal septal swell body volume reduction for patients with nasal obstruction. Laryngoscope. 2015;125(7):1523-28.

PARTICULARS OF CONTRIBUTORS:

1. Postgraduate Resident, Department of ENT, Datta Meghe Institute of Higher Education and Research, Jawaharlal Nehru Medical College, Wardha, Maharashtra, India.
2. Professor, Department of ENT, Datta Meghe Institute of Higher Education and Research, Jawaharlal Nehru Medical College, Wardha, Maharashtra, India.
3. Associate Professor, Department of ENT, Datta Meghe Institute of Higher Education and Research, Jawaharlal Nehru Medical College, Wardha, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Senu Sunnychan,
Postgraduate Resident, Department of ENT, Datta Meghe Institute of Higher Education and Research, Jawaharlal Nehru Medical College, Wardha, Maharashtra, India.
E-mail: senusunnychan@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: May 02, 2023
- Manual Googling: Jun 15, 2023
- iThenticate Software: Jul 22, 2023 (8%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? NA
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Apr 26, 2023**
Date of Peer Review: **May 24, 2023**
Date of Acceptance: **Jul 31, 2023**
Date of Publishing: **Aug 01, 2023**